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RESPONSE OF 55-YEAR-OLD LODGEPOLE PINE TO THINNING,

by

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Does lodgepole pine (Pinus contorta) as old as 55 years respond to thinning? Very little research has been done to answer this question for central Oregon stands because until recently they have been considered largely unmerchantable Now, however, this species is recognized as a good potential source of pulpwood and small saw logs, and information is needed on growth and yield of thinned as well as unthinned stands This note presents results from a 22-year record of a thinning experiment on the Pringle Falls Experimental Forest in central Oregon.

THE EXPERIMENT

Three half-acre plots were established in July 1934 in a 55-year-old, fully stocked, even-aged stand. One plot was thinned from below to approximately 12- by 12-foot spacing, a second was thinned from below to approximately 16- by 16-foot spacing, and a third was left unthinned (table 1). Most of the slash on the thinned plots was removed and burned. Tree measurements were made at 5- to 7-year intervals; the most recent measurement was made in 1956.

STAND CONDITIONS IMMEDIATELY BEFORE AND AFTER THINNING

Before thinning, the three plots were fairly similar in stand characteristics and in distribution of trees by crown class The stand designated for 12X12 spacing, however, had a slight initial advantage in average diameter and average height and a greater

basal area and cubic-foot volume than the other two treatments (table 1). Almost no understory vegetation or lodgepole pine reproduction was present.

Table 1.--Stand characteristics before thinning, after thinning, and 22 years later[1/]

(Per acre)

Stand age (years) and treatment	Number of trees	Average d.b.h.	Average height	Basal area	Volume[2/]
	Number	Inches	Feet	Square feet	Cubic feet
55 (before thinning):					
Thinned (16X16)	574	5.4	45	92.7	2,445
Thinned (12X12)	616	5.9	47	116.3	3,181
Unthinned	630	5.4	45	101.3	2,648
55 (after thinning):					
Thinned (16X16)	164	6.9	50	42.9	1,228
Thinned (12X12)	298	6.9	50	78.2	2,238
Unthinned	630	5.4	45	101.3	2,648
77:					
Thinned (16X16)	112	10.6	65	68.2	2,441
Thinned (12X12)	214	9.6	65	107.5	3,927
Unthinned	436	6.7	56	107.8	3,467

[1/] All trees 2.6 inches d.b.h. and larger.

[2/] Basis: Table 49, "Volume Tables for the Important Trees of the United States (Pt. 1--Western Species)," compiled by E. N. Munns and R. S. Brown, U.S. Forest Serv., 1925.

After thinning, the plots provided a wide range in stand density and volume--from 164 to 630 in number of trees, from 43 to 101 in square feet of basal area, and from 1,228 to 2,648 in cubic feet of wood volume. Because thinning was from below, the 12X12 and 16X16 spacings had a greater average diameter and height after treatment than the unthinned stand (table 1).

The original stand was seriously infected with two species of bark rust, Cronartium stalactiforme and Peridermium harknessii. Even though the healthiest trees were left after thinning, 67 percent were infected to some extent. No bark beetle problem was evident at time of thinning.

Site quality is medium for this area. Tree heights indicate an index of 61 by the British Columbia site curves.[1/]

DIAMETER GROWTH

Annual diameter growth in inches of all trees and of the 100 largest trees per acre during 22 years after thinning averaged:

	All trees	100 largest trees
Stand treatment:		
Thinned (16X16)	0.156	0.172
Thinned (12X12)	.108	.132
Unthinned	.064	.100

For all trees, diameter growth in the 16X16 stand exceeded that in the 12X12 stand by 1-1/2 times and in the unthinned stand by 2-1/2 times. When only the 100 largest trees per acre are considered, these relative rates are reduced to 1-1/3 and 1-3/4, respectively.

Differences among treatments in the progression of average stand diameter over the 22-year period were even more pronounced--an increase of 3.7 inches in the 16X16 spacing and 2.7 inches in the 12X12 compared with only 1.3 inches in the unthinned stand (table 1). All three criteria show that diameter growth of lodgepole pine in central Oregon responds markedly and positively to thinning release.

[1/] British Columbia Forest Service. Volume, yield, and stand tables for some of the principal timber species of British Columbia. Compiled by Res. Div. Brit. Columbia Forest Serv., 53 pp., illus. 1936.

HEIGHT GROWTH

Thinning has apparently also stimulated height growth. This is in part reflected by the increase in estimated average height of all living trees over the 22-year period since thinning--14.4 feet in the 16X16 spacing and 14.2 feet in the 12X12 compared with 11.2 feet in the unthinned stand.

BASAL AREA AND CUBIC VOLUME INCREMENT

During the 22-year period of record, the 12X12 spacing has made the highest periodic net increment in terms of both basal area and cubic volume (table 2). At age 77, this spacing had regained sufficient volume to surpass the unthinned stand by 460 cubic feet per acre (table 1). Periodic increment in the heavily thinned stand (16X16) was intermediate between the other two treatments. In both thinned stands, however, nearly all increment was on trees over 6 inches in diameter.

Table 2.--Annual net increment, mortality, and gross increment for the 22-year period following thinning[1/]

(Per acre)

Treatment	Periodic annual net increment		Periodic annual mortality		Periodic annual gross increment	
	Basal area	Volume	Basal area	Volume	Basal area	Volume
	Sq.ft.	Cu.ft.	Sq.ft.	Cu.ft.	Sq.ft.	Cu.ft.
Thinned (16X16)	1.15	55.1	0.73	22.7	1.88	77.8
Thinned (12X12)	1.32	76.7	1.04	32.0	2.36	108.7
Unthinned	.29	37.2	1.89	53.0	2.18	90.2

[1/] All trees 2.6 inches d.b.h. and larger.

MORTALITY

Periodic mortality since thinning has been highest in the unthinned stand, intermediate in the 12X12 spacing, and lowest in the 16X16 spacing (table 2). Records on causes of mortality, though not complete, indicate bark beetles, bole cankers, and root rot were the principal agents. Under all treatments, most losses occurred in the smaller diameter classes.

Although substantially reduced by thinning, mortality continued to be an important factor in the thinned stands and accounted for about 30 percent of their periodic gross increment. This emphasizes the need for more information on the causes and control of mortality in lodgepole pine stands.

REDISTRIBUTION OF GROWTH

Levels of periodic gross increment since thinning provide a rough measure of the degree to which growth potential has been transferred to the leave trees in the thinning treatments. In the 12X12 spacing, levels of gross increment have remained consistently higher than those in the unthinned stand (table 2). This indicates growth was redistributed promptly and satisfactorily under this more conservative thinning treatment. For the 16X16 spacing, however, periodic gross volume increment has averaged less than that in the unthinned stand for the 22-year period since thinning; it surpassed the unthinned stand only in the most recent measurement period (1951-56). The 16X16 spacing was apparently too severe a thinning treatment to permit rapid and complete redistribution of volume growth.

COMMERCIAL VALUES

So far, our volume comparisons have all been based on the total stand--all trees 2.6 inches d.b.h. and larger. A more realistic measure of the influence of thinning on present tree sizes and commercial values is illustrated by the volumes[2/] per acre of trees that attained pulpwood or sawtimber sizes at age 77:

	Pulpwood size (7-11 inches d.b.h.) (Cords)	Sawtimber size (12 inches d.b.h. or larger) (Board feet, Scribner)
Treatment:		
Thinned (16X16)	12.2	4,036
Thinned (12X12)	21.5	5,856
Unthinned	21.8	1,125

[2/] Basis: "Volume Tables for Pacific Northwest Trees," compiled by F. A. Johnson. U.S. Dept. Agr. Handb. 92, 122 tables. 1955.

In terms of pulpwood-size trees (7-11 inches d.b.h.) alone, no gains in cordwood volume can be attributed to thinning. In fact, the heavy (16X16) thinning has produced fewer trees in these smaller merchantable size classes. In terms of sawtimber-size trees (12 inches d.b.h. or larger), however, thinning has increased board-foot yields at age 77 by three to five times.

Assuming stumpage values of $2 per cord for pulpwood-size trees and $6 per thousand board feet (Scribner) for sawtimber-size trees, timber crop values per acre in 1956 would be about as follows:

Thinned (16X16)	$48.62
Thinned (12X12)	78.14
Unthinned	50.35

The $28 difference between the stand thinned to 12 by 12 feet and the unthinned stand approximates the current cost of carrying out such a thinning operation in central Oregon. This indicates the cost of the 12X12 thinning (without interest) could be regained in about 22 years. If a pulpwood market were available at time of thinning, the financial aspects would, of course, be brighter.

The extent to which thinning has accelerated the movement of trees into merchantable size classes is also illustrated by the stand graphs in figure 1. For both thinned stands, the curves have advanced strongly into the larger diameter classes during the 22 years since thinning. In contrast, the main change in the unthinned stand is the reduction of stems under 7 inches d.b.h., due largely to mortality.

CHANGES IN UNDERSTORY VEGETATION

When the study was first established, the ground under the lodgepole pine stand was almost free of vegetation or tree seedlings. Now the heavily thinned stand (16X16) has an abundance of needle grass, some Idaho fescue and yarrow, occasional clumps of lodgepole pine seedlings, and a few scattered saplings. The lightly thinned stand (12X12) has numerous small patches of lodgepole pine seedlings and a light sprinkling of grasses. In the unthinned stand, however, no apparent change in understory vegetation has occurred.

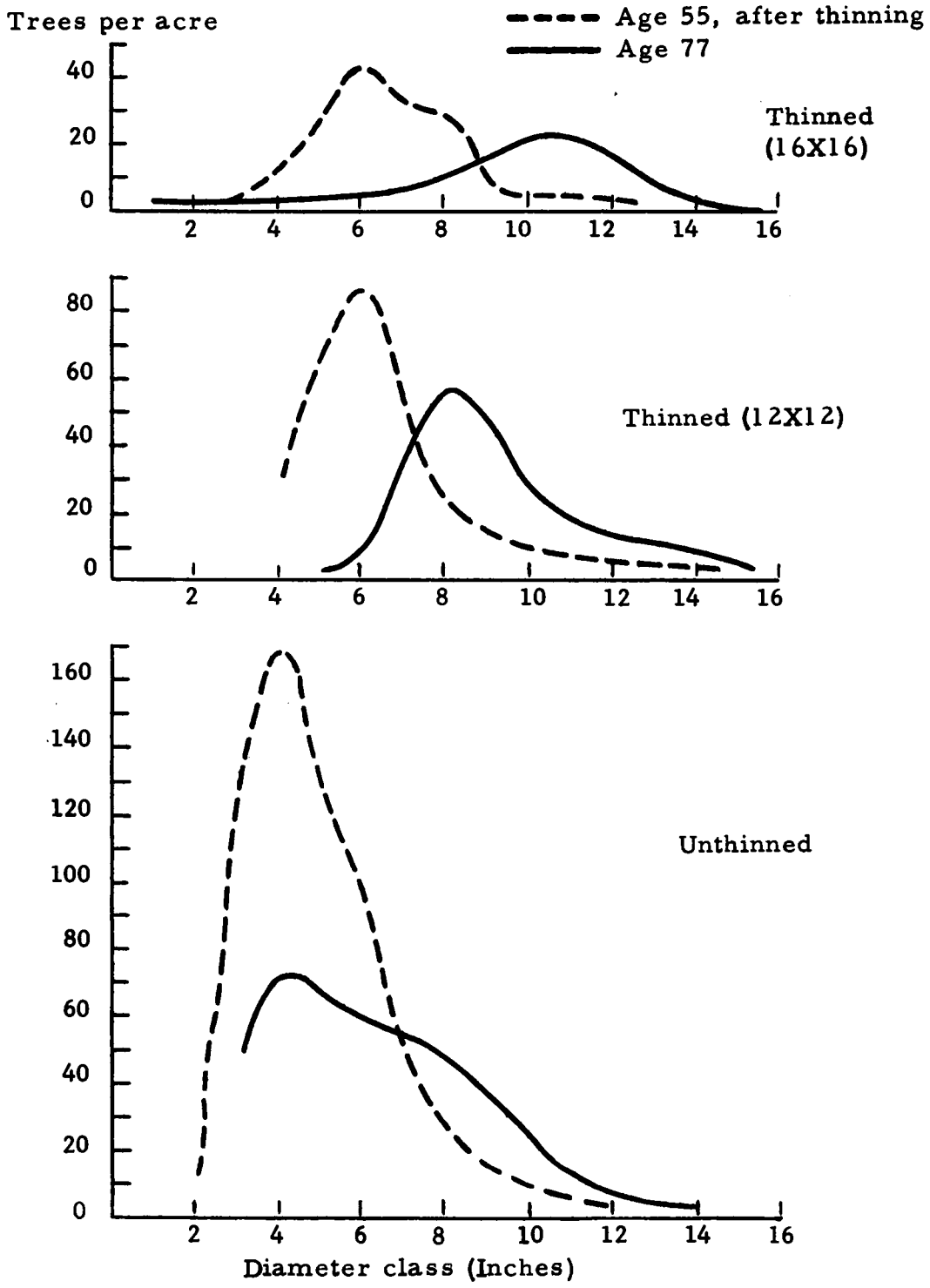

Figure 1.--Stand graphs of lodgepole pine stands at time of thinning (age 55) and 22 years later (age 77).

CONCLUSION

An unmanaged stand of lodgepole pine in central Oregon responded exceptionally well to a first thinning at the comparatively late age of 55 years. Diameter growth was stimulated markedly, mortality was reduced, and stems grew more rapidly into merchantable size classes. Thinning to a spacing of 12 by 12 feet at age 55 produced higher yields and merchantable volumes at age 77 than thinning to a spacing of 16 by 16 feet. During this 22-year period, understory vegetation has changed from a sparse condition to a plentiful supply of grasses in the heavily thinned stand.

These trends suggest that thinning on some lodgepole pine sites may possibly increase both timber and forage production.